

**Director's Independent Conceptual Design and
Critical Decision 1 Readiness Review
of the
LHC CMS Detector Upgrade Project
May 14-16, 2013**

Charge

The Committee is to conduct a Director's Review of the LHC Compact Muon Solenoid (CMS) Detector Upgrade Project. This review consists of two parts, the first part is an Independent Conceptual Design Review and the second is a Critical Decision 1 (CD-1) Readiness Review. The LHC CMS Detector Upgrade Project received CD-0 on September 18, 2012. The Project anticipates receiving DOE Critical Decision 1 (CD-1) "Approve Alternative Selection & Cost Range" late summer of 2013.

The LHC CMS Detector Upgrade Project is the design and construction of upgrades to the Hadron Calorimeter, the Silicon Pixel detector, and the Level 1 Trigger subsystems of the CMS detector at CERN. The LHC, running at 8 TeV center of mass energy, has nearly reached its design luminosity. It is expected that with planned upgrades, it will exceed the original design by a factor of at least two. CMS was not designed to run efficiently at the luminosity now projected for the next several years. With these upgrades, the detailed study of the properties of the new boson and the search for new physics that should be associated with it can take full advantage of the excellent performance of the LHC and resolve many of the open questions in electroweak physics.

The Independent Conceptual Design part of the review is to verify that the LHC CMS Detector Upgrade Project design is technically adequate and should achieve the Project's scientific goals. To meet the requirements for CD-1 the design has to be at the conceptual level or greater. The committee will make their assessment based on the LHC CMS Detector Upgrade Project's Conceptual Design Report (CDR), drawings, specifications, and discussions with the project team.

For the CD-1 Readiness part of the review the Committee will focus on the project's cost, schedule, management, and ESH&Q. The project will present a Cost Range that the review and the committee is to assess and determine if it is appropriate based on the following factors: the scope of work; the maturity of the design; the Basis of Estimate (BOE); and the risks associated with the scope of work. The team will also look at the WBS – Work Breakdown Structure, WBS Dictionary, BOE – Basis of Estimate documentation, risk and contingency analyses, RLS – Resource Loaded Schedule, and time phased funding and cost profiles. The committee is asked to review each of these items, for quality, completeness, and accuracy. Furthermore, the committee is asked to review and assess the quality of and comment on the additional formal project management documentation required for CD-1 approval.

The committee is to assess the progress of the Project's preparations to meet the CD-1 requirements of DOE O 413.3B to determine the state of readiness to move to a DOE CD-1 Independent Project Review (IPR). To meet CD-1 readiness LHC CMS Detector Upgrade Project's conceptual design needs to be sound and achievable and that the project documentation (schedule and basis of estimate) is develop to a level to support the cost and schedule range presented. The review committee is asked to address the questions in Attachment 1 to assess the Project's progress.

Finally, the committee should present findings, comments, recommendations, and answers to the above questions at a closeout meeting with LHC CMS Detector Upgrade Project and Fermilab's management. A written report will be provided within two weeks after the review.

Attachment 1

Independent Conceptual Design Review Charge Questions

1. Are the science goals and physics requirements clearly stated and documented? Have the science goals and physics requirements been adequately translated into technical performance requirements and specifications?
2. Is the design technically adequate? Is the design likely to meet the technical requirements needed to carry out the scientific goals?
3. Can the design be constructed, inspected, tested, installed, operated and maintained in a satisfactory way?
4. Is there adequate supporting documentation to support the conceptual design and the transition to developing the preliminary design?
5. Are the risks (on technical, cost, and schedule basis) of the selected base design approach and alternatives understood and are appropriate steps being taken to manage and mitigate these risks? Have areas been identified where value engineering should be done? If value engineering has been performed is it documented?
6. Are the project organization and lines of responsibility clearly defined and sufficient to ensure the successful engineering and design of the project? Are the design interfaces between the US CMS Upgrade Project and the International CMS Upgrade at CERN understood and well defined to ensure a coordinated effort and an integrated design? Is there a reasonable plan in place for implementing configuration management to ensure changes to the technical requirements/specifications are controlled and communicated to all affected groups?

CD-1 Readiness Review Charge Questions

7. Has the Project developed a quality resource loaded schedule that includes the entire project's scope of work and is it achievable?
8. Are the estimated cost and proposed schedule ranges realistic, consistent with the technical and budgetary objectives, and justified by the supporting documentation? Has all the work been appropriately identified, estimated and scheduled, including the work associated with performing the preliminary design, final design and value engineering activities?
9. Has the Project implemented a Risk Management Process by identifying risks, performing a risk assessment and started developing mitigation plans at an appropriate level for the CD-1 stage?
10. Is the Project Team adequately staffed and does it possess adequate experience to successfully carry out the Project?
11. Is the current staffing level adequate to complete the work to achieve CD-2? If not, has the appropriate staffing level been identified in the schedule and has a staffing plan been developed to acquire the future staffing needs?
12. Are ESH&Q aspects being properly addressed given the project's current stage of development?
13. Are the draft Key Performance Parameters (KPPs) achievable base on the design, cost range and schedule range presented?

14. Is the documentation required by DOE O 413.3B and Fermilab's Project Management System in order?
15. Is the scope of work clearly defined between what is funded by DOE or NSF, and is this reflected in the cost, schedule and risk assessment presented to the committee?
16. Has the relationship been clearly defined between the LHC CMS Detector Upgrade Project and International CMS at CERN?
17. What is the state of readiness of the LHC CMS Detector Upgrade Project for a DOE CD-1 Independent Project Review (IPR)?